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SETTLING BASIN EFFICIENCY AT PHILADELPHIA

By Joseph S. V. Siddons

The Torresdale filter plant, located 10 miles above the center of the City of Philadelphia on the Delaware River, includes a series of slow sand units (final filters) which total 48¾ acres in area and 120 preliminary or roughing beds each having an area of 1200 square feet. A covered filtered water basin of 50,000,000 gallons capacity receives the filtered and treated water prior to its flow into a tunnel leading to the Lardner's Point Station, from which the filter delivery is pumped into the city distribution system.

Prior to October, 1916, water was introduced to the preliminary units by pumping directly from the river. Following this date the suction to the station was transferred to a sedimentation basin which had been constructed along the river shore adjacent to the slow sand filter location. Excavation was made by dredging, and cribbing was sunk and loaded with gravel and earth to form a dike which acts as a dividing wall between the river proper and basin. The intake is provided with control gates and baffles and over it is built a head house where chemicals may be stored and treatment applied. The basin is approximately 2000 feet long and 500 feet wide and ranges, due to tidal conditions, from 15 to 21 feet in depth. The quantity of water within the basin limits permits of a subsidence period of approximately twelve hours.

The introduction of the sedimentation basin reduces to a marked extent the amount of suspended matter which at times of a turbid river would add to the removal load of the filter. Should conditions warrant, suction from the river may be effected by opening the gates of the former intake. The water enters the sedimentation basin about one-half mile upstream from the old location, thereby offering less chance of flood tide pollution from the city's drainage.

In February, 1918, during a period of high turbidity, a coagulant was applied. The effect of the basin upon the plant operation on dates subsequent to the basin's use, is given in table 1.

TABLE 1

Million gallons yield of Torresdale filters between cleanings

	MAXIMUM		MINIMUM		DAYS RUN		
	Per filter	Per acre	Per filter	Per acre	Maximum	Minimum	Average
To the end of 1916	569	758	30	37	148	11	30
During 1917	815	1087	53	71	240	25	99
During 1918	695	927			233		

The above are yields following washing by the Nichols' method. The record for 1918 is not complete, as a number of filters started in the last quarter have not up to date completed their runs.

The number of cleaning operations on the final filters for years 1915 to 1918 are respectively 719, 491, 360 and 312. Due consideration must be given to the labor conditions which prevailed during 1918, when shortage necessitated a revision of filter cleaning practice and the effort was to return a bed to service as rapidly as might be permitted. The use of the basin made it practicable to handle smaller quantities of sand and give a serviceable filter unit which would furnish a satisfactory effluent. The amount of sand handled during 1917 and 1918 was respectively 157,000 and 90,000 cubic yards.

The effect of the subsidence period in the basin is shown in table 2, which represents turbidity counts taken over a six months' period. The removal by the preliminary units is also expressed.

TABLE 2

Turbidity counts during six months

	MAXIMUM	MINIMUM	AVERAGE	PERCENTAGE REMOVED
River	34	6.0	11+	*
Applied to pre-filters	31	4.0	10+	14.4
Applied to final filters	8	0.5	1+	93.0

* Average is carried to decimals to produce per cent removed.

The Delaware water normally permits of an alum dose of 1.5 grains per gallon and this coagulant is applied in solution. Typical results expressing turbidities are shown in table 3.

TABLE 3

River and effluent turbidities

SULPHATE OF ALUMINA APPLIED	RIVER	APPLIED TO ROUGHING FILTERS	APPLIED TO FINAL FILTERS
1.6 grains per gallon	176	57	19
1.5 grains per gallon	150	60	16
1.7 and 1.3 grains per gallon*	75	46	8

* One day of this period the readings were 100, 20 and 2, which reflects favorably upon the action of the pre-filters and arouses the thought that this series of beds might be operated as a mechanical plant.

Results of cleaning operations during 1917 are given in table 4.

TABLE 4

Yield in million gallons, Torresdale filters, 1917

METHOD	NUMBER OF FILTERS	TOTAL	PER FILTER			PER ACRE		DAYS RUN		
			Maximum	Minimum	Average	Maximum	Minimum	Maximum	Minimum	Average
Nichols wash	146	41,781	815	53	287	393	4.0	240	25	99
Raked (once)	133	15,820	304	29	119	159	4.3	96	13	37
Raked (twice)	24	1,316	100	19	55	73	3.8	35	8	19
Brooklyn	45	6,196	292	42	138	184	3.9	96	20	47
Scraped and piled	12	1,474	136	24	123	164	3.8	50	11	43
Totals	360	66,587			185	247	3.9			63

An approximate yield and the cleaning operation which produced the runs are given in table 5.

TABLE 5

Cleaning operations and following yields

NUMBER OF BEDS		YIELD
Washed	Raked*	
1	35	Less than 50,000,000 gallons
8	46	Between 50,000,000 and 100,000,000 gallons
32	63	Between 100,000,000 and 200,000,000 gallons
47	12	Between 200,000,000 and 300,000,000 gallons
28	1	Between 300,000,000 and 400,000,000 gallons
21	0	Between 400,000,000 and 500,000,000 gallons
6	0	Between 500,000,000 and 600,000,000 gallons
1	0	Between 600,000,000 and 700,000,000 gallons
1	0	Between 700,000,000 and 800,000,000 gallons
1	0	Maximum 815,000,000 gallons
146	157	

* Maximum of rakes 304,000,000 gallons.